

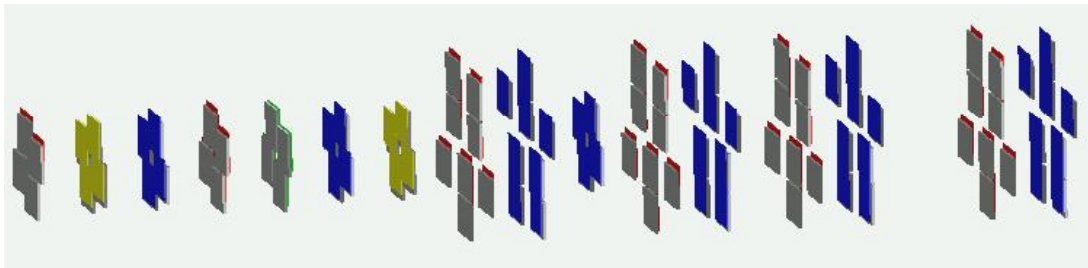
# Operation and Performance of the NA60 Pixel Telescope in Heavy-Ion Collisions

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The NA60 experiment aims at studying the production of prompt dimuons and of open charm with proton and heavy ion beams at the CERN SPS. The NA60 detector complements the muon spectrometer and zero degree calorimeter previously used in NA50 with new state-of-the-art silicon detectors placed in the target region. A radiation tolerant beam tracker, made of silicon microstrip detectors, operated at 130 K, gives the transverse coordinates of the interaction point with a precision around 20  $\mu\text{m}$ . This allows us to measure the offset of the muon tracks and thereby select events where a pair of D mesons was produced in the collision.

Downstream of the nuclear targets and inside a 2.5 T dipole magnet, a silicon tracking telescope measures the charged tracks and allows to identify which one of them provides the best match to the muon recorded in the muon spectrometer, placed behind a hadron absorber. For proton runs, this telescope can consist of silicon microstrip planes, while the high multiplicity of charged particles produced in heavy ion collisions imposes the use of pixel detectors.

The pixel telescope consists of 16 independent detector planes, arranged along the beam axis. Each plane comprises several pixel detector assemblies, either 4 or 8 depending on the distance from the target, resulting in a total of 96 assemblies with approximately 800,000 channels. The layout of the full pixel telescope is shown in Fig. 1

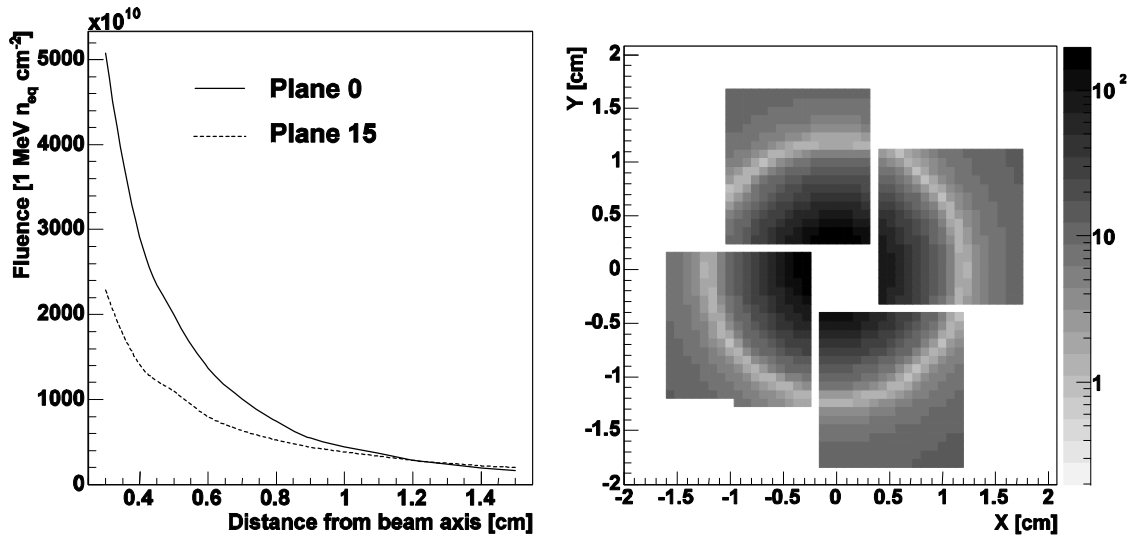


**Figure 1:** Layout of the NA60 pixel telescope. The beam is coming from the left; the planes closest to the target are made from 4 single chip assemblies, the planes further downstream contain 8 assemblies each

The assemblies are made from radiation tolerant ALICE1LHCB readout chips bump bonded to p-on-n silicon pixel sensors. Each sensor chip contains  $32 \times 256$  pixels of  $50 \times 425 \mu\text{m}^2$ . The assemblies are glued and wire bonded to a carrier hybrid, which contains all necessary signal and power lines to operate and read out the chips.

The full telescope was operated in 2003 with In-In collisions. Results from the operation of the pixel telescope in the high-multiplicity environment of heavy-ion collisions are presented.

During the run a significant radiation dose with a very inhomogeneous distribution was collected, reaching several  $10^{13}$  1 MeV  $n_{eq}/cm^2$  in the most central pixels of each plane and about a factor of 10 less in the outermost pixels (Fig. 2).



**Figure 2:** Simulated fluence in the most upstream and the most downstream plane of the telescope (left) and expected depletion voltage in a four-chip plane (right). The ring of pixels with depletion voltages close to 0 V consists of pixels that are close to type-inversion; the more central pixels are already type-inverted whereas the outer ones still show their original behaviour.

The inhomogeneous distribution of the radiation damage leads to a drastically changing behaviour of the pixels within one sensor: the innermost pixels reached type inversion very soon and the depletion voltage subsequently rose to 100 V and more, whereas the outermost pixels kept nearly their initial behaviour throughout the run. This paper shows that the operation of the partially type-inverted sensors posed no obvious problems. Furthermore, measurements of the leakage current and the spatial dependence of the depletion voltage are presented and compared with the expectation.